

Atopic dermatitis and ascariasis in children aged 2 to 10 years

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Abstract

Objective: To assess the association between atopic dermatitis (AD) and ascariasis in 2 to 10-aged children from the neighborhood Pedregal, in the city of Campina Grande, Brazil, an area of low socioeconomic index.

Methods: Cross-sectional study conducted with the use of the standard questionnaire from the International Study of Asthma and Allergies in Childhood (ISAAC) and stool parasitological exam for *Ascaris lumbricoides*. The dependent variable was AD diagnosis: absent, mild, and severe. Multivariate logistic regression and descriptive analysis of the variable were used. Associations were estimated using relative risk (RR) and odds ratio (OR). The statistical inference was based on 95% confidence intervals (95%CI).

Results: We assessed 1,195 children, 612 (51.2%) female. The AD prevalence was 24.6%, and ascariasis prevalence was 26.1%. In the mild AD group of children, 44 (36.7%) were infected by *A. lumbricoides*, while in the severe AD group, 40 (22.9%) had the same geohelminthosis ($p = 0.01$). Comparing negative cases of AD between mild and severe forms, the infection with *A. lumbricoides* increased the frequency of mild AD (RR = 1.7; $p = 0.009$), but not the severe form (RR = 0.86; $p = 0.46$). Evaluating only the positive cases of dermatitis, 120 mild AD (40.8%) and 176 with severe AD (58.2%), it can be said that the exposure to the parasite decreased the frequency of the severe form of dermatitis (RR = 1.46; $p = 0.016$).

Conclusion: There is a high prevalence of AD and of ascariasis in the population studied. The severe AD is related to lower parasitemia of *A. lumbricoides*.

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Introduction

Atopic dermatitis (AD), or atopic eczema, is an inflammatory disease that generally occurs in patients with family background of atopy.¹ In industrialized countries, it is the most frequent inflammatory dermatosis in children.² Genetic patterns, breastfeeding period, environment allergens, early use of antibiotics, and even the decrease in size of families have been related to risk factors to AD.³ On the other hand, viral, bacterial

infections, or immunization with BCG help to explain TH1-TH2 dicotomy.⁴

AD prevalence in Brazil is studied using the International Study of Asthma and Allergies in Childhood (ISAAC) standard questionnaire.⁵ In children from Manaus, Natal, Salvador, São Paulo, and Itajaí, Brazil, the prevalence of mild eczema varied between 8.6 and 13.1%, while that of severe eczema, in those same places, was of 3.4 to 8.5%.⁶

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As AD, helminthes-generated infection is very frequent in developing countries^{7,8} and have been associated to allergic diseases. In Brazil, ascariasis is one of the most common parasitoses.⁹ In Campina Grande, Brazil, in a previous study in the same area, a prevalence of 56.3% of *Ascaris lumbricoides* was observed.¹⁰

The high prevalence of atopy in urban areas of developing countries was related to the reduction of the exposition to geo-helminths.¹¹⁻¹³ Other studies, as that of Lynch et al.¹⁴ and that of Williams & Flohr,¹⁵ observed a reduction of risk of sensitization to allergens in children infected by *A. lumbricoides*. In a previous study, in the Pedregal community, Campina Grande, the association of asthma and ascariasis was not observed.¹⁴ Leonardi-Bee et al.,¹⁶ in a meta-analysis, associated the infection by *A. lumbricoides* to a significant increase of asthma risk. Medeiros et al.¹⁷ observed the association between asthma and *Schistosoma mansoni*.

Despite the high prevalence of AD and ascariasis, no studies showing the association among these two pathologies were found in Brazil. In Campina Grande, in the neighborhood of Pedregal, a high frequency of allergic diseases, as well as enteroparasitoses, was observed, which motivated the study on the possible association between AD and ascariasis.¹⁸

Methods

The population studied was constituted of children with ages ranging from 2 to 10 years old living in the neighborhood of Pedregal, in the city of Campina Grande, Brazil. In this community there are 2,655 families registered by the Family Health Program (Programa de Saúde da Família, PSF), with approximately 1,600 children in the age group studied, according to data provided by the Municipal Secretary of Health. The neighborhood population is estimated in 10,706 inhabitants, and the children studied respond for 14.9% of all the inhabitants.¹⁹

The study started in January, 16th, 2007 and ended in November, 19th, 2007. The ISAAC standard questionnaire (eczema mode) was applied to the responsible people for the 1,582 children during the home visit, and a recipient for feces collection was handed over. In this occasion the clinical dermatologic exam of the children was also conducted and the requirements of the informed consent form filled. The parasitological exam was done in the Parasitology Laboratory, Academic Unit of Medicine of the Universidade Federal de Campina Grande (UFCG), Campina Grande, Brazil. Of the 1,582 children, 1,195 (75.5%) continued the study, presenting fecal samples for the coproparasitological exam. Due to temporary closing of the PSF of Pedregal, which prevented the samples to be handed over, 387 children (24.5%) were excluded.

Campina Grande is a city located 7°13'50" of latitude south, 35°52'52" of longitude west, 552 meters of altitude, where temperature variances between 15 to 30 °C and relative humidity of air around 82% (Instituto Nacional de Meteorologia, INMET) are observed; the city also has high pluviometric indexes (754 mm per year in 2007, and 866 mm until August, 2008, according to the Agência Executiva de Gestão das Águas do Estado da Paraíba, AESA). Children who live in the area use light clothes and present various dermatological problems, such as scabiosis, pityriasis versicolor, and molluscum contagiosum, a typical disease of hot countries.

The ISAAC questionnaire was applied to assess AD and its symptoms. According to its criteria, the 'eczema that appears and disappears in the last 12 months' is considered mild AD, and 'eczema, flexural lesions in the last 12 months and night itching', severe AD. The cases were distributed in three groups: no AD, mild AD, and severe AD.

In the research on *A. lumbricoides* the methods of Ritchie and Kato-Katz were used. All children with ascariasis were treated with mebendazol (100 mg, twice a day during 3 days), and those who had other enteral parasitoses were medicated according to indication.

The analytic procedures included univariate and multivariate descriptive analysis of logistic regression. In the multivariate analysis all the variables that presented value of $p < 0.2$ were introduced in the logistic regression model, in association with AD, remaining in the model all that presented value of $p < 0.05$. The associations were estimated by relative risk (RR) and odds ratio (OR), and statistic inferences were based on 95% confidence intervals (95%CI).

The dependent variable was the diagnosis of absent AD, mild AD, and severe AD. The covariables were age, gender, family income, mother's degree of instruction, family background of allergy, and presence of *A. lumbricoides*-generated infection. Age, a continuous variable, was categorized in four groups: 2-3 years old, 4-5 years old, 6-7 years old, and 8-10 years old. In relation to family income, the sample was divided in 3 groups: < 1 minimum wage, 1-2 minimum wages and ≥ 2 minimum wages. The variable 'mother's degree of instruction' was assessed in two groups: 1) illiterate mothers or who have not completed primary education, and 2) mothers who have completed primary education and of more instruction. The softwares Statistical Package for Social Sciences (SPSS) 10.0, Windows version, and STAT 9.2 were used in the analyses.

The research project was approved by the Research Ethics Committee on Human Beings of the Hospital Universitário Alcides Carneiro, (UFCG), Campina Grande (May 22, 2006).

Results

In the demographic variables analysis of the 1,195 children studied, 51.2% (n = 612) were female, with no difference in proportions according to sex observed. In relation to age, the average was 5.58 years, with standard deviation 2.58. The age group with the bigger number of children was 8-10 years (28.3%). Family income lower than or equal to one minimum wage was found in 91.1% of the families. And in the variable 'instruction', most of the mothers (68.4%) had not completed primary education.

The prevalence of ascariasis was 26.1% (n = 312), and that of AD was 24.7% (n = 296). From these cases, 40.5% had mild AD, and 59.4%, severe AD.

In the AD cases, there was no difference between male and female (p = 0.258), neither association with age (p = 0.205). For family income analysis, we included the groups that received one to two minimum wages and > than two minimum wages, excluding the group that received less than one minimum wage because it had no difference from the group with income of one to two minimum wages. A statistically significant relation between family income and AD (p = 0.022) was seen. The lowest income was seen as a protection factor for mild AD (RR = 0.42; 95%CI 0.23-

0.78) and severe AD (RR = 0.52; 95%CI 0.30-0.91). In the analysis of mother's degree of instruction, there was no statistically significant difference between the studied groups (RR = 0.71; 95%CI 0.42-1.20; p = 0.16) (Table 1).

Still in Table 1, if we analyze the presence of ascariasis, it was observed that there is an association with AD (p = 0.016). Comparing negative cases of AD with mild and severe AD cases, the presence of *A. lumbricoides*-generated infection increased the occurrence of mild AD (RR = 1.7; p = 0.009), but not of severe AD (RR = 0.86 p = 0.46).

If we assess only positive mild AD cases (n = 120; 40.8%) and severe AD (n = 176), it is possible to see that the exposition to the parasite decreases the occurrence of the severe form (RR = 1.46; p = 0.016).

In Table 2, the family background of allergic diseases such as asthma, rhinitis, urticaria, and AD in mother and brothers is observed. The presence of severe AD in children was more common when the mother had rhinitis (RR = 1.62; p = 0.02) or AD (RR = 2.69; p = 0.085) and when the brothers have AD (RR = 6.16 (p = 0.001).

In the multivariate logistic regression analysis comprising family factors and the presence of *A. lumbricoides*, to observe the association of them with AD and its mild and

Table 1 - Univariate analysis of the association between atopic dermatitis with demographic variables and ascariasis in children 2-10 years old in the neighborhood of Pedregal, Campina Grande, Brazil

Variables	Dermatitis			RR (95%CI) "No" vs. "mild AD"	p	RR (95%CI) "No" vs. "severe AD"	p
	No n (%)	Mild n (%)	Severe n (%)				
Sex (p = 0.258)							
Female	466 (51.8)	53 (44.2)	93 (52.8)	-	-	-	-
Male	433 (48.2)	67 (55.8)	83 (47.2)	1.36 (0.92-1.99)	0.115	0.96 (0.69-1.32)	0.807
Age group (p = 0.205)							
2-3 years	252 (28.0)	30 (25.0)	50 (28.4)	-	-	-	-
4-5 years	215 (24.0)	25 (20.8)	48 (27.3)	0.97 (0.55-1.71)	0.934	1.12 (0.72-1.74)	0.596
6-7 years	189 (21.0)	21 (17.5)	26 (14.8)	0.96 (0.72-1.30)	0.818	0.83 (0.64-1.07)	0.159
8-10 years	243 (27.0)	44 (36.7)	52 (29.5)	1.15 (0.97-1.35)	0.098	1.02 (0.89-1.18)	0.728
Family income (p = 0.022)							
< 1 MW	67 (7.4)	17 (14.2)	21 (11.9)	-	-	-	-
1 - < 2 MW	426 (47.4)	46 (38.3)	70 (39.8)	0.42 (0.23-0.78)	0.006	0.52 (0.30-0.91)	0.022
≥ 2 MW	406 (45.2)	57 (47.5)	85 (48.3)	0.89 (0.67-1.20)	0.481	0.97 (0.75-1.24)	0.789
Instruction (p = 0.197)							
Illiterate and primary education incomplete	720 (80.1)	102 (84.7)	149 (85.0)	-	-	-	-
Primary education complete or more	179 (19.9)	18 (15.3)	27 (15.0)	0.71 (0.42-1.20)	0.203	0.73 (0.47-1.13)	0.160
<i>Ascaris lumbricoides</i> (p = 0.016)							
Presence	228 (25.4)	44 (36.7)	40 (22.7)	1.0	-	1.0	-
Absence	671 (74.6)	76 (63.3)	136 (77.3)	1.70 (1.14-2.54)	0.009	0.86 (0.59-1.26)	0.460

Table 2 - Multivariate analysis of association of atopic dermatitis with family background for allergy in children with ages ranging from 2 to 10 years in the neighborhood of Pedregal, Campina Grande, Brazil

Variables	Dermatitis			RR (95%CI) "No" vs. "mild AD"	p	RR (95%CI) "No" vs. "severe AD"	p
	No n (%)	Mild n (%)	Severe n (%)				
Mother asthma (p = 0.298)							
No	679 (77.4)	90 (71.9)	120 (76.3)	1.0	-	1.0	-
Yes	198 (22.6)	28 (28.1)	47 (23.7)	1.06 (0.67-1.68)	0.779	1.34 (0.92-1.94)	0.121
Mother rhinitis (p = 0.020)							
No	616 (70.2)	82 (59.3)	99 (69.5)	1.0	-	1.0	-
Yes	261 (29.8)	36 (40.6)	68 (30.5)	1.03 (0.68-1.57)	0.868	1.62 (1.15-2.28)	0.005
Mother urticaria (p = 0.184)							
No	885 (97.7)	115 (95.2)	159 (97.5)	1.0	-	1.0	-
Yes	20 (2.3)	3 (4.8)	8 (2.5)	1.11 (0.32-3.81)	0.862	2.15 (0.93-4.96)	0.073
Mother AD (p = 0.085)							
No	863 (98.4)	116 (98.3)	160 (95.8)	1.0	-	1.0	-
Yes	14 (1.6)	02 (1.7)	7 (4.2)	1.06 (0.23-4.73)	0.936	2.69 (1.07-6.78)	0.035
Brother asthma (p = 0.678)							
No	284 (39.4)	52 (35.6)	32 (36.6)	1.0	-	1.0	-
Yes	437 (60.6)	58 (64.4)	90 (63.4)	1.17 (0.74-1.85)	0.482	1.12 (0.77-1.63)	0.536
Brother rhinitis (p = 0.274)							
No	284 (39.4)	36 (32.4)	46 (40.0)	1.0	-	1.0	-
Yes	436 (60.6)	54 (67.6)	96 (60.0)	1.09 (0.73-1.62)	0.665	1.18 (0.85-1.64)	0.317
Brother urticaria (p = 0.152)							
No	673 (93.3)	84 (88.7)	126 (93.3)	1.0	-	1.0	-
Yes	48 (6.7)	6 (11.3)	16 (6.7)	1.20 (0.74-1.96)	0.448	1.09 (0.70-1.70)	0.672
Brother AD (p = 0.001)							
No	673 (93.2)	81 (90.0)	98 (69.0)	1.0	-	1.0	-
Yes	49 (6.8)	09 (10.0)	44 (31.0)	1.52 (0.72-3.22)	0.268	6.16 (3.89-9.75)	< 0.001

95%CI = 95% confidence interval; AD = atopic dermatitis; RR = relative risk.

severe forms (Table 3), one can observe that the presence of the parasite has a strong association with the mild form of AD (OR = 2.26; 95%CI 1.38-3.68; $p < 0.001$). Having brothers with AD increases significantly the risk of AD in its severe form (OR = 5.9 95%CI 3.63-6.69; $p < 0.001$), much more than maternal rhinitis (OR = 1.55; 95%CI 1.04-2.31; $p < 0.028$). Mother's AD increases the risk of severe AD in the children (OR = 3.15; 95%CI 0.98-10.1; $p < 0.053$).

Discussion

The presence of AD is a genetically predictive condition, moderated by environmental factors.²⁰ AD prevalence has been well studied after the recording of data obtained by the ISAAC questionnaire.^{5,6} The higher values were observed in urban centers in Africa, Australia, North and West Europe, and the lower values, in China, Eastern Europe and Asia.

In Brazil, ISAAC phase 3 showed significant differences in various assessed centers, with data varying in the item 'eczema' from 7.3 to 13.3% and, in 'flexures eczema', from 5.3 to 13.1% in children 6-7 years old.⁶

The association between AD and ascariasis have been little studied, despite their being considered high prevalence pathologies in the whole world, both in developed and developing countries.^{7,8} This status was observed in this study, endorsed by low income and mother's low instruction degree.

Even if an instrument for the qualification of the precarious socioeconomic and hygiene and sanitary conditions have not been addressed, these conditions exist in the neighborhood of Pedregal and they favor the presence of geohelminths and other parasitoses. *A. lumbricoides* prevalence was lower than the one seen in a previous study (56.3%),²¹ possibly due to the prophylactic prescription of antihelminthic medication by the PSF professionals before the verification of the presence of parasites in coproparasitological exam.

The parasitary infection diagnosis in a cross-sectional study with single fecal material collection may indicate both a new infection and a chronic infection. The absence of infection may also indicate, presumably, non-exposition or a recent treatment.^{7,12}

Climate may affect asthma and AD prevalence in children.²² The prevalence found by Solé et al.²³ in centers

Table 3 - Multivariate analysis of the factors 'presence of *Ascaris lumbricoides*' and family background for allergy in atopic dermatitis in children from 2 to 10 years old in the neighborhood of Pedregal, Campina Grande, Brazil

Variables	Raw OR (95%CI) "No" vs. "mild AD"	p	Adjusted OR (95%CI) "No" vs. "severe AD"	p
<i>Ascaris lumbricoides</i>				
Absence	1,0	-	-	-
Presence	2.26 (1.38-3.68)	0.001	1.02 (0.63-1.64)	0.917
Brother with AD				
No	1,0	-	-	-
Yes	1.57 (0.73-3.37)	0.245	5.94 (3.63-6.69)	< 0.001
Mother with rhinitis				
No	1.0	-	-	-
Yes	1.28 (0.82-2.10)	0.253	1.55 (1.04-2.31)	0.028
Mother with AD				
No	1.0	-	-	-
Yes	1.79 (0.36-8.82)	0.46	3.15 (0.98-10.1)	0.053

95%CI = 95% confidence interval; AD = atopic dermatitis; RR = relative risk.

near to the line of the Equator (Manaus, 12.0% in 'eczema' and 8.0% in 'flexures eczema'; and Natal, 13.1 e 13.0%, respectively) show high prevalence, coinciding with this study. In a study conducted in Nigeria, where climatic conditions similar to Northeastern Brazilian ones are observed, Nnoruka et al.²⁴ considered as aggravating factors of AD the intolerance to heat, excessive transpiration and in-house humidity.

Atmospheric pollution would be an aggravating factor, as documented by Fernández-Mayoralas et al.,²⁵ a fact that was not observed in a study conducted in Brazil, in cities with a higher pollution level.²³ In the neighborhood of Pedregal, home garbage burnings are frequent, and families that use firewood and coal in their kitchens are found, which are aggravating factors for allergic diseases.

The presence of *A. lumbricoides* in children in this study protected them of severe AD, possibly by immunological mechanisms. This same phenomenon was observed by Wordemann et al. in Cuban children.⁷ Dagoye et al. suggested that the reduction of parasitic infections may be a determining factor to the increase of allergic diseases in developed and developing countries.¹³ The immunological mechanism of this relation is yet controversial. The answer may lie in the model involving the TH1-TH2 dichotomy, when the exposition to helminthes favor a bigger TH2 stimulation, which is also observed in allergic diseases.²⁶ This way, the presence of ascariasis shows a contrary effect in allergic diseases' severity.

Since a high prevalence of enteroparasitoses¹⁰ are observed in the area studied and all the children present a complete vaccination schedule, a decrease in allergic

disease and the triggering of TH1 immune protective factors occurrence, working as a mechanism for lower AD occurrence, would be expectable.^{14,27}

The high prevalence of atopy in children's relatives was affirmed by Sebok et al.,²⁸ who associated allergic diseases to genetic heritage of father, mother, grandparents, and relatives. Therefore, family background is one of the most important factors for diagnosis and it expresses the patient's atopic constitution. In this study, atopy among mothers with rhinitis, and AD, and that of brothers, with AD are related. Among them, the greater risk of the severe form of AD in children was originated from the patient having a brother with AD, corroborating the idea of genetic predisposition. Mothers and brothers studied shared the same environment, so heredity could be assessed. Information gathering on the father was hindered, for most mothers assume responsibility for their children alone.

Data obtained in this study show that for 2 to 10 year-old children living in urban area with low socioeconomic indexes, infestation by *A. lumbricoides* could be a determining factor for a lower AD severity.

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